Name _____ Date _____ Class Period _____

Activity B

5.1 Modeling Linear Relationships

MATERIALS • 8.5 inch by 11 inch piece of paper • inch ruler

QUESTION How can you model a linear relationship?

You know that the perimeter of a rectangle is given by the formula $P = 2l + 2w$. In this activity, you will find a linear relationship using that formula.

EXPLORE Find perimeters of rectangles

STEP 1 Find perimeter

Find the perimeter of a piece of paper that is 8.5 inches wide and 11 inches long. Record the result in the table.

Width of fold (inches)	Perimeter of rectangle (inches)
0	
1	
2	
3	
4	

STEP 2 Change paper size

Measure 1 inch from a short edge of the paper. Fold over 1 inch of the paper. You now have a rectangle with the same width and a different length than the original piece of paper. Find the perimeter of this new rectangle and record it in your table.

STEP 3 Find additional perimeters

Unfold the paper and repeat Step 2, this time folding the paper 2 inches from a short edge. Find the perimeter of this rectangle and record the result in your table. Repeat with a fold of 3 inches and a fold of 4 inches.

DRAW CONCLUSIONS Use your observations to complete these exercise

1. What were the length and the width of the piece of paper before it was folded? By how much did these dimensions change with each fold?

2. What was the perimeter of the piece of paper before it was folded? By how much did the perimeter change with each fold?

3. Use the values from your table to predict the perimeter of the piece of paper after a fold of 5 inches. *Explain* your reasoning.

4. Write a rule you could use to find the perimeter of the piece of paper after a fold of n inches. Use the data in the table to show that calculations using this rule give accurate results.

Width of fold (inches)	Measured perimeter (inches)	Calculated perimeter (inches)
0		
1		
2		
3		
4		
5		

Answer Key B

EXPLORE

Width of fold (inches)	Perimeter of rectangle (inches)
0	39
1	37
2	35
3	33
4	31

DRAW CONCLUSIONS

1. 8.5 inches by 11 inches; 1 inch
2. 39 inches; 2 inches
3. 29 inches; Answers may vary. Sample answer: the perimeter decreases by 2 times the width of the fold.
4. $P = 39 - 2n$

Width of fold (inches)	Measured perimeter (inches)	Calculated perimeter (inches)
0	39	$39 - 2(0) = 39$
1	37	$39 - 2(1) = 37$
2	35	$39 - 2(2) = 35$
3	33	$39 - 2(3) = 33$
4	31	$39 - 2(4) = 31$

Teacher Notes

ACTIVITY PREPARATION AND MATERIALS

- If there are not enough rulers for each member of the class this activity can be done in pairs.
- Decide how you will divide the class into pairs.
- You can use paper that is a size other than 8.5 inches by 11 inches. Doing so will affect the answers in the table in the Explore and answers involving perimeter in the Draw Conclusions exercises.
- Ideally the paper should have a 90° angle at each corner. Using paper with rounded corners (such as some notebook paper) will make measuring difficult.

ACTIVITY MANAGEMENT

- Remind students that the perimeter of a rectangle is given by the formula $P = 2l + 2w$. Explain that in this activity they will find the perimeters of different rectangles.
- Some students may discover the pattern for the perimeter after a few folds and will not need to repeat the folding process to complete the table.
- You may want to have students compare the perimeters recorded in their tables before starting the Draw Conclusions exercises.
- Students should not have trouble answering Exercises 1–3 using the information in their table.
- Students may have a harder time writing a rule in Exercise 4. Many will notice that the perimeter decreases by 2 inches every time the fold width is increased by 1 inch, but may have trouble making the jump to using n to represent the width of the fold. Ask students to consider how the width of the fold changes the perimeter as compared to the original perimeter of the paper.
- **A-Level Alternative** Answer Exercise 4 as a class. A-Level students may need more guidance in writing the rule.
- **C-Level Alternative** Have students graph their results. After graphing students could determine whether or not the relationship is linear, find the slope and y-intercept, and discuss what values of n are reasonable given the original size of the paper.

Activity and Closure Questions

Ask these questions as a class.

1. Find the perimeter of the piece of paper after a fold of 7 inches.

   Answer: 25 inches

2. Can the rule you wrote in Exercise 4 be used to find the perimeter of the piece of paper after a fold of 2.3 inches? *Explain*. Find the perimeter if possible.

   Answer: Yes, the rule can be used for any width fold less than 11 inches. 34.4 inches

3. Can the rule you wrote in Exercise 4 be used to find the perimeter of the piece of paper after a fold of 12 inches? *Explain*. Find the perimeter if possible.

   Answer: No, the paper is only 11 inches long, the width of the fold cannot be greater than the length of the paper.

4. Does the rule you wrote in Exercise 4 model a linear relationship? *Explain*.

   Answer: Yes, the perimeter decreases at a constant rate.

LESSON TRANSITION

This activity allows students to model a linear relationship. After completing the activity remind students of the definitions of *y-intercept*, *slope*, and *slope-intercept form*. Have students write their rule from Exercise 4 in slope-intercept form, ask them to identify the slope and *y*-intercept. You could then begin the lesson with Example 2 on page 283.